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ABSTRACT

This curriculum guide for metalworking courses is part of a series of curriculum guides for use in the industrial arts curriculum in Connecticut. The guide provides information on the scope and sequence of the industrial arts curriculum, specific guidelines for industrial arts, program goals and objectives, and guidelines concerning special education students and Public Law 94-142 requirements. Course outlines are given for exploratory, intermediate, and advanced level metalworking courses, and a metalworking safety guide is included. The curriculum guide also contains reference to specific areas of metalworking. (This curriculum guide provides material for intermediate grades, secondary, and adult vocational education courses in metalworking.) (KC)

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INDUSTRIAL ARTS CURRICULUM GUIDE

FOR

METALWORKING

State Department of Education

Division of Vocational and Adult Education

May, 1982

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(20 U.S.C. 122 1c(b) (1))

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INTRODUCTION

What is a metal and why is it important to study metals? A "metal" is defined as any of a class of elements characterized by a distinctive luster, malleability, ductility, thermal and electrical conductivity, and capable of forming positive ions. Metals are usually thought of as being hard, strong, heavy or capable of resisting heat. Metals also possess unusual characteristics such as; light weight combined with high strength, low melting temperatures, softness or being liquid at room temperature. Metals can also possess other characteristics, such as, resistance to corrosion, abrasion and extreme high temperature. Metals may be combined to form alloys which may change or enhance the characteristics of the metals and produce new desired attributes. Metals may be formed, shaped, cut, finished, cast and fabricated into a variety of useful shapes and objects.

Metals are important because our civilization depends upon metals in one form or another. Since historic times, the discovery of metals and their alloys continued to be responsible

for much of the development of civilization. The economic wealth of a country is measured in part by the use of metals.

Today, just about everything we come in contact with in our daily lives has used metal or metal processes in its manufacture. Almost every product in American industry contains metal parts or is manufactured by machines made of metal parts. More workers are employed in metal working or metal working related industries in the United States than any other industry. The economic and military strength of our country depends on the competence of the millions of metal trade employees.

A few of the benefits of studying metal working:

The study of metal working will increase the understanding of occupational requirements and opportunities.

The study of metal working provides the opportunity to develop and practice skills leading to vocational competence.

The study of metal working will provide insights and skills basic to engineering and technical programs.

The study of metal working will help develop an appreciation

of good design and the ability to select, care for, and use products of industry.

The study of metal working will help promote and develop safe work habits.

The study of metal working will provide for direct application of problem solving and math and science skills.

The study of metals will provide the opportunity for hands on activity, group interaction and interdependence, as well as the possibility for self expression and the development of leisure time activities.

INDUSTRIAL ARTS SCOPE AND SEQUENCE

Industrial Arts learning experiences are sequential, beginning in the lowest grades and continuing through adult and higher education. As an integral part of the total educational program, Industrial Arts is designed to meet student's needs as they relate to a modern technological society. Through manipulative and research experiences, with a variety of tools, machines, processes and products of industry, students develop an awareness of how industry and its many components function.

A comprehensive Industrial Arts program will provide for a sequence of courses in industrial areas. These include, but are not limited to:

drafting
electricity/electronics
general lab
graphic arts
industrial ceramics
metal technology
plastic technology
power technology
wood technology

The objectives of Industrial Arts are:

..... To develop an insight and understanding of industry, its place in our society, and the free enterprise system.

..... To develop problem solving skills related to the materials, tools, processes and products of industry.

..... To provide for a degree of skill development through a series of sequential courses in common industrial areas with vocational emphasis at the advanced levels.

..... To develop knowledge of the tools, machines, materials and processes of industry through their practical and safe use.

..... To develop an appreciation of good design and craftsmanship.

..... To develop an understanding of industrial and technological career opportunities and their requirements.

..... To develop those traits which will help students obtain and maintain employment.

..... To develop consumerism regarding the goods and services of industry.

..... To discover avocational and recreational interests.

..... To understand the affects of industry and civilization upon the environment.

The following sequential phases represent a range of Industrial Arts activities from kindergarten through adulthood. Reference is made to grade level to assist LEA's in planning. It is understood that a wide variety of grade organizations are employed based upon local situations.

I. Self-Awareness (grades K-6)

Industrial Arts at this level is designed to familiarize students with the many kinds of work people do and the tools and materials they use. It is at the elementary level that Industrial Arts activities are used to enhance basic skills and understandings in all curricular areas by providing relative hands-on experiences.

II. Industrial Arts Exploration (grades 7 & 8)

Industrial Arts at the middle school/jr. high school level

is designed to foster the development of a strong foundation in the concepts, skills, knowledges and attitudes regarding not only the technical but also the related and social aspects of general education.

Industrial Arts experiences at this level are exploratory in nature. The program provides students with the opportunity to develop a better understanding of their interests, abilities and aspirations. Consumer knowledge as it relates to industrial products and processes is an inherent part of these activities. A broad exploratory Industrial Arts program at the middle school/jr. high school level allows individual student's interests to become more discernible for concentration at the senior high level.

III. Industrial Arts Occupational Orientation (grades 9 & 10)

Industrial Arts at this level emphasizes occupational orientation. It is here that the transition from middle schcol/jr. high school exploratory experiences to specialization at the upper levels is made. Students may explore

in greater depth a wider variety of areas, evaluate their performances, aptitudes and interests and begin to formulate career plans.

IV. Industrial Arts Specialization (grades 11 & 12)

At this level students are provided the opportunity to specialize in one or more occupational areas and to develop pre-vocational skills. Training at this level should prepare students to maximize their career options after high school.

This level should also assist individuals in making informed and meaningful occupational choices and/or prepare them for entry into advanced trade and industrial or technical education programs.

V. Adult, Continuing and Higher education Industrial Arts programs are designed for adults and out of school youth. These programs are avocational, pre-vocational or

vocational in nature depending upon the needs of the individual and the demands of society.

Specific Guidelines For Industrial Arts

Grade Level

7 - 12 and Adult

Selection of Students

Open to all students who can profit from instruction, and work safely in a Lab/Shop situation

Length of Program

Level One (Exploratory) grades seven (7) and eight (8) - Lab/Shop classes meet a minimum of 60 hours per year. Lab/Shop periods must be of at least 40 continuous minutes and should not exceed 60 minutes.

Level Two (Occupational Orientation) grades nine (9) through twelve (12), or grades ten (10) through twelve (12) - students electing Level Two Industrial Arts courses must have the opportunity to participate in a minimum of 225

minutes of Lab/Shop activities per week, per semester. Daily Lab/Shop pericds must be of at least 45 continuous minutes and should not exceed 60 minutes.

Level Three & Four (Specialization and Pre-Vocational) grades eleven (11) and twelve (12). Students that elect Level III & IV Industrial Arts courses must have a minimum of 450 minutes per week, per year of Lab/Shop activities. Daily Lab/Shop periods must be of at least 90 continuous minutes.

The definition of a year is a minimum of 180-day school days. A semester is 90 continuous school days.

Pre-Requisites

Successful completion of Level Two course prior to participating in Level Three. Successful completion of Level Three course prior to Level Four.

Enrollments

Based on Lab/Shop size and facilities, 16 students per class maximum in Lab/Shop areas and 20 students per

class in drafting. The recommended and minimum square footages are as follows:

Shop/Lab

	Recommended		Minimum	
Jr. & Sr. High School	s.f./pupil station	Net total s.f. area	s.f./pupil station	Net total s.f. area
Drafting (including storage)	48 sf	1200 sf	40 sf	1000 sf
I.A. Jr. H.S. Level One (including storage)	100 sf	2500 sf	82 sf	2050 sf
I.A. Sr. H.S. Levels Two, Three & Four (including storage)	144 sf	3600 sf	120 sf	3000 sf

A classroom should be made available for related study, adjacent to the Shop/Lab areas. All facilities must comply with OSHA regulations.

Teachers Schedule

Industrial Arts contact hours for a full-time instructor should comprise 70% to 80% of their school week, and 20% to 30% of their time in industrial arts related non-teaching duties, such as

maintenance and preparation of I. A. materials.

Equipment

All equipment must be in safe operating condition and conform to all federal, state, and local standards.

Equipment must be:

A. Applicable to the level being taught, i.e., size, capacity, quantity, and necessity.

B. Enhance the program level and be similar to that found in industry.

C. Take into consideration: occupational education, consumer competency, leisure time activity, and environmental awareness.

Evaluation

Continuous evaluation by students, teachers, school, vocational, advisory committee, and state. Evaluation results must become an integral part of program development and improvement.

School Credit

Equal to other academic credit granted for similar periods of time and activities.

Youth Organizations

It is recommended that the American Industrial Arts Student Association (AIASA) be an integral part of the curriculum.

Teacher Certification

Instructors shall meet the minimum standards for Industrial Arts teachers provisional certification as outlined in the "Rules and Regulations Concerning State Teacher Certification" section 10-146-21 and section 10-146-22.

Standard certification requires three (3) years of teaching under a provisional certificate, the last two (2) years consecutive and a master's degree or thirty (30) semester hours, consisting of a planned program at an approved institution of higher learning and an individual program, mutually determined and approved by teacher and supervising agent.

Teachers of Industrial Arts to be funded through the

Vocational Education Acts must comply with section 10-146-22 above, have one (1) year of appropriate occupational experience and complete Principles of Vocational Education, a three (3) semester hour Vocational-Technical Education course.

Sex Stereotyping

Existing activities and future plans must show evidence of actions directed toward the elimination of sex stereotyping, including continual effort to attract females to elective industrial arts courses traditionally chosen by males. Industrial arts courses which are required for any students at a particular level must be required of all students, male and female.

PUBLIC LAW 94-142

"THE EDUCATION FOR ALL HANDICAPPED CHILDREN ACT"

This law requires that all handicapped children requiring special education have available a free and appropriate public education in the least restrictive environment. The law establishes guidelines for meeting this goal. Following are some terminology the instructor should be familiar with.

Special Education is specially designed instruction at no cost to parents. It must meet unique needs of handicapped children and be provided with a written individualized education program (IEP).

An Individualized Education Program is a written document by parents and teachers for a handicapped child before he receives special education. The IEP is produced by a planning and placement team (PPT) meeting. The IEP reviews the present educational performance of the child, goals and objectives for the child, and specific services to be provided by the school.

A Planning and Placement Team is a legally established group developing or reviewing the IEP for a handicapped child. It is composed of teachers and the child's parent(s) to review information regarding the student in response to a referral for special education evaluation or to conduct an annual review.

Handicapped means:

(a) A person who is

1. Mentally retarded
2. Hard of hearing
3. Deaf
4. Speech impaired
5. Visually handicapped
6. Seriously emotionally disturbed
7. Orthopedically impaired
8. Other health impaired person, or persons with specific learning disabilities

(b) Who, by reason of the above

1. Requires special education and related services
2. Cannot succeed in the regular vocational education program without special educational assistance

3. Requires a modified vocational education program

(Federal Register, Vol. 42, No. 191, Oct. 3, 1977, p53864)

Disadvantaged means:

(a) Persons (other than handicapped persons) who

1. Have academic or economic disadvantages
2. Require special services, assistance, or programs in order to enable them to succeed in vocational education programs.

(b) Academic Disadvantage, for the purposes of this definition of disadvantaged, means that a person:

1. Lacks reading and writing skills
2. Lacks mathematical skills
3. Performs below grade level

(c) Economic Disadvantage, for the purposes of this definition of disadvantaged, means

1. Family income is at or below national poverty level
2. Participant or parent(s) of participant is recipient of public assistance
3. Participant or parent(s) or guardian of the participant is unemployed

4. Participant is institutionalized or under State guardianship

(Federal Register, Vol. 42, No. 191, Oct. 3, 1977, p52864)

Mainstreaming: Though this term does not occur in P.L. 94-142, it is a coined term thought to mean placing all handicapped learners into regular classrooms. This is not the intent of the law. Rather, handicapped learners should be placed in the least restrictive environment.

Least Restrictive Environment: Public schools must assure that, to the maximum extent appropriate, handicapped students are to be educated with non-handicapped students. Separate classes should occur only when the severity of the handicap is such that education in the regular classroom with supplementary aids cannot be accomplished adequately. If a handicapped student is disruptive to the extent of interferring with the learning of other students in a classroom, this placement would be considered inappropriate. Thus a shop, home economics class, business class, may be inappropriate for some handicapped learners.

Role of the Special Needs Teacher: The special needs teacher should be supportive to the extent of helping the regular teacher identify specific characteristics and needs of every special needs student. He should help, when needed, in teaching special needs students in the classroom. Needs and placement should be jointly determined by the regular and special needs teacher.

Funding: There are no provisions for class size, but Federal Regulations do provide for "the use of supplementary aids and services". Federal reimbursed funds for vocational education (including Industrial Arts) under the Education and Vocational Handicapped Act, provide 10% set-aside funds for the handicapped, and 20% for the disadvantaged.

GENERAL OBJECTIVES

I. The student will learn and follow safe procedures as practiced in industrial organization and apply them in the industrial arts laboratory situation.

II. The student will learn and practice shop personnel organization and safe interaction with others.

III. The student will learn about types, forms, shapes, and composition of metals and apply that knowledge to the proper selection of materials for their individual projects.

IV. The student will learn about drawing, planning, and the reading and interpretation of blueprints as used in the shop situation and will apply skills to produce their own drawings and plans.

V. The student will learn the use of measuring tools and instruments and apply such use in their individual work and in class work.

VI. The student will learn the principles and procedures of layout and use of layout tools and demonstrate the use through application to individual projects and class work.

VII. The student will learn the proper and safe use of metal cutting tools and demonstrate their use.

VIII. The student will learn the proper and safe use of tools, and methods to form and shape metal, and apply them to shop activities.

IX. The student will learn the procedure and methods of joining and fastening metals and demonstrate their use in shop activities.

X. The student will learn foundry procedures and practices in the production of casting and apply them in the production of metal castings.

XI. The student will learn the procedure for heat treatment of metals and demonstrate these procedures.

XII. The student will learn the procedures and methods of metal finishing and apply them in the completion of the projects.

XIII. The students will learn about a variety of vocational fields so they can maximize their career options in the future.

XIV. The student will develop an appreciation for and understanding of good design as it applies to project development as well as consumer information.

INTRODUCTION TO EXPLORATORY METALWORKING

First Exposure to the Area

This is an introductory course in the study of the basic processes, materials and methods used by our industrial, technological society to create goods, products and/or services that are made or provided of a metallic nature to benefit our lives. Students in the course will study the basic hand and some machine processes that are used by industry to alter or change the shapes of these materials into suitable products or projects for our use and consumption.

Industrial Arts metalworking experiences at this level are exploratory in scope and sequence. The program provides students with the opportunity to develop a better understanding of their own interests, abilities and aspirations.

This guide is designed to be a comprehensive metal-working curriculum designed for a typical junior high or middle school program. Individual community needs and resources will determine the extent to which this guide is used.

CURRICULUM EXPLORATORY METALWORKING

I. Introduction to Industrial Arts & the world of metals

- A. Shop procedure and regulations - behavior
- B. Shop safety
  1. See safety section of curriculum guide
  2. Fire exits and procedures
  3. Emergency switches and shut-offs
- C. Shop organization and procedure
- D. Maintenance of tools and equipment
- E. Course syllabus and expectations, requirements

II. Shop Safety (continuous)

- A. Eye protection
  1. Glasses
  2. Face shields
  3. Welding helmets
  4. Welding goggles
  5. Foundry goggles

B. Personal protection

1. Clothing - loose clothing
2. Jewelry - rings, watches, chains
3. Hair
4. Proper protective clothing
   a. aprons
   b. coats
   c. gloves, when needed
   d. spats (foot protection)
5. Ventilation & Illumination

C. Material Handling

1. Heavy materials
2. Sharp materials
3. Hot materials
4. Material handling equipment
5. Hazardous materials
   a. gases
   b. flammables
   c. solvents

D. Shop maintenance

1. Equipment and tools

2. Cleanup

3. Chips & Scrap

4. Oil spills and water

III. Materials

A. Types of materials

B. Characteristics of metals

C. Uses of metals

D. Metal classifications

1. Ferrous metals

2. Non-ferrous metals

E. Identification of metals

F. Standard forms and shapes

G. Cost, comparison, estimating

H. Reclaiming & Salvage

IV. Measurement

A. Use of measurement, (English & Metric)

B. Simple and accurate measurement

C. Measuring instruments and tools

1. Steel rule, tape rule
2. Calipers
3. Micrometers
4. Protractor
5. Combination Squares
6. Gauges
7. Dividers & Compasses
8. Weight scales
9. Calculators

V. Drawing and planning

A. Use and importance of drawing and sketching

B. Types of drawings and sketches

C. Reading sketches and drawings

D. Bill of materials and procedures

VI. Layout

A. Purpose and use of layout

B. Layout tools and instruments

1. Steel rule

2. Scribers & Pencils

3. Squares

4. Layout dye

5. Prick punch and center punch

6. Hammer

7. Dividers

8. Compasses

9. Calipers

10. Marking gauge

11. Combination square set

12. Protractor

13. Trammel

14. V-block

C. Layout Procedure & Techniques

VII. Holding Devices

A. Vises

B. Clamps

C. Pliers

VIII. Cutting

A. Hand Tools

1. Chisel and hammer
2. Saws
3. Shears
4. Pliers, cutting
5. Punches
6. Notcher
7. Hand Nibblers
8. Bolt cutters
9. Tubing & Pipe Cutters
10. Hand drills & Twist Drills
11. Taps & Dies

B. Machines

1. Power hand drill
2. Drill press
3. Bench grinder
4. Bandsaw
5. Power hack saw
6. Buffer
7. Lathe

8. Squaring shear

9. Strip belt sander

10. Bench shears

IX. Shaping and Forming

A. Hand Tools

1. Files

2. Hammers & mallets

3. Bending forks

4. Dies, Raising, Fluting, etc.

5. Scroll bender

6. Metal twister

7. Crimper

8. Stakes

9. Anvil

10. Hand seamer

11. Hand groover

B. Machines and Power Tools

1. Box and pan break

2. Rotary machines (combination)

3. Bar folder

4. Slip-form roller

5. Bending machines

X. Joining and Fastening

A. Fastening Devices

1. Threaded fasteners

2. Rivets

B. Fastening Processes

1. Soldering & Brazing

2. Welding

3. Adhesives

4. Bending & Seaming

XI. Foundry Procedures and Practices

A. Foundry Safety

B. Tools, Equipment and materials

1. Flask

2. Rammer

3. Spoons

4. Sprue cutters

5. Riddle

6. Lifter

7. Trowel

8. Bellows

9. Ladles

10. Crucible

11. Tongs

12. Parting Compound

13. Sands

14. Casting Metals

C. Patterns & Fluxes

D. Foundry Procedures

1. Furnace Operation

2. Molding Procedure

3. Pouring Procedure

4. Shake-out

5. Trimming, Cleaning & Finishing

XII. Heat Treatment

A. Safety

B. Furnace Operation

C. Purposes & Methods

1. Annealing

2. Hardening

3. Tempering

4. Case Hardening

XIII. Metal Finishing

A. Hand Processes

1. Abrading

2. Filing

3. Steel Wooling

4. Painting & Coloring

5. Polishing

6. Surface Treatments (peening, planishing, etc.)

7. Wire Brushing

B. Machine Processes

1. Buffing

2. Belt and Disc Sanders

3. Wire Wheel

4. Plating

XIV. Career and Vocational Guidance

A. Metalworking Occupations

B. Occupational Outlook and Opportunities

C. Occupational Requirements

D. Guidance

XV. Consumer Awareness

A. Product selection and function

B. Design

C. Economic Factors

D. Product Integrity ,

INTRODUCTION TO METALWORKING

SECONDARY LEVEL

The committee has attempted to design a curriculum covering the widest possible applications of metalwork and equipment. The curriculum at the secondary level is divided into three segments - - - Introductory, Intermediate, and Advanced. While the program is basically designed for a three year high school, it is possible to select from the various units of the curriculum, and design a four year program. It is probable that no one school can provide this entire program, but it can select from the areas most applicable to its needs and equipment, and design an appropriate program for its students. Flexibility has always been a primary goal of Industrial Arts in Connecticut. It is the belief of the committee that each school should survey the overall curriculum, and then design its individual program.

CURRICULUM INTRODUCTORY METALWORKING

I. Introduction to area

A. Shop procedure and regulations

1. Behavior

2. Mental Attitude

3. Physical Condition

B. Shop Safety

1. Fire exits and procedures

2. Emergency switches and shut-offs

3. Ventilation and illumination

II. Shop Safety

A. Eye Protection

1. Glasses

2. Face shields

3. Welding helmets and goggles

4. Goggles

B. Personal Protection

1. Clothing - loose clothing

2. Jewelry - rings, watches, chains

3. Hair

4. Proper protective clothing

a. aprons

b. coats

c. gloves

d. spats (foot protection)

C. Material Handling

1. Heavy materials

2. Sharp materials

3. Hot materials

4. Material handling equipment

5. Hazardous material

a. gases

b. flammables

c. solvents

D. Shop Maintenance

1. Equipment and tools

2. Cleanup

3. Chips and scrap

4. Oil spills, water

III. Materials

A. Types of materials

B. Characteristics of metals

C. Uses of metals

D. Metal classification

1. Ferrous metals

2. Non-ferrous metals

E. Identification of metals

F. Standard forms and shapes

G. Cost, comparison, estimating

H. Reclaiming and salvage

IV. Measurement

A. Use of measurement, English/metric

B. Simple and accurate measurement

C. Measuring instruments and tools

1. Steel rule, tape rule, etc.

2. Calipers, dividers

3. Micrometers

4. Protractor

5. Depth measurement instruments

6. Combination set

7. Gauges

D. Instruction and practical uses of instruments

V. Drawing and Planning

A. Use and importance of drawings and prints, communication

B. Types of drawings

C. Drawing symbols and lines

D. Freehand sketching, using symbols and lines

E. Blueprint reading

F. Related information on drawings

G. Student planning sheet

1. Drawing

2. Materials list

3. Materials costs

4. Procedural steps

VI. Layout

A. Purpose and use of layout

B. Layout tools and instruments

1. Surface plate
2. Scriber
3. Layout dye
4. Steel rule
5. Prick punch and center punch
6. Hammer
7. Dividers
8. Hermaphrodite caliper
9. Marking gauge
10. Combination square set
11. Steel protractor
12. Trammel
13. Surface grinder
14. Angle plate
15. V Blocks
16. Clamps

C. Layout Procedures

VII. Cutting

A. Hand Tools

1. Chisel and hammer
2. Saws
3. Shears
4. Pliers
5. Punches
6. Notcher
7. Squaring Shear
8. Oxyacetylene cutting
9. Nibbler
10. Pipe and tubing cutter
11. Taps and dies
12. Hand reamer

B. Power Hand Tools

1. Sabre saw
2. Portable electric saws
3. Electric shears
4. Nibbler
5. Portable hand grinder
6. Engraver
7. Portable electric drill

C. Power Driven Machines

1. Drill press
2. Bench grinder
3. Bandsaws
4. Power hacksaw
5. Sanders
6. Lathe

VIII. Shaping and Forming

A. Hand tools

1. Files
2. Hammers
3. Hand bender
4. Bending jigs
5. Scroll bender
6. Metal twister
7. Crimper
8. Stakes
9. Anvil
10. Hand seamer
11. Hand groover

B. Machines and Power Tools

1. Box and pan brake
2. Rotary machine
3. Bar folder
4. Slip-form roller
5. Bending machines

IX. Holding Devices

A. Vices

B. Clamps

C. Pliers

X. Joining and Fastening

A. Fastening Devices

1. Threaded fasteners
2. Rivets

B. Fastening Processes

1. Soldering/Brazing
2. Welding
3. Adhesives
4. Bending and seaming

C. Hand Tools

1. Screwdrivers

2. Wrenches

XI. Foundry Procedures and Practices

A. Foundry safety

B. Tools and equipment and materials

C. Patterns

D. Foundry Procedure

1. Furnace Operation

2. Molding Procedure

3. Pouring Procedure

4. Shake-out

5. Trimming and cleaning

XII. Heat Treatment

A. Safety

B. Furnace Operation

C. Methods

1. Tempering

2. Annealing

3. Case Hardening

4. Hardening

XIII. Metal Finishing

A. Hand Processes

1. Coated abbrasives

2. Files

3. Steel wool

4. Painting

5. Polishing

6. Surface treatments

7. Wire brush

B. Machine Processes

1. Buffing

2. Belt and disc sanders

3. Wire wheel

4. Sand blasting

5. Tumbling

XIV. Career and Vocational Guidance

Metalworking occupations and careers

XV. Consumer Awareness

A. Product selection and function

B. Design

CURRICULUM INTERMEDIATE METALWORKING

I. Introduction to area

A. Review shop procedure and regulations behavior

B. Review shop safety

1. Fire exits and procedures

2. Emergency switches and shut-offs

C. Review shop organization and procedure

D. Review maintenance of tools and equipment

E. Introduce course syllabus and expectations, requirements

II. Review shop safety

A. Eye protection

1. Glasses

2. Face shields

3. Welding helmets

4. Welding goggles

B. Personal protection

1. Clothing - loose clothing

2. Jewelry - rings, watches, chains

3. Hair

4. Proper protective clothing

   a. aprons

   b. coats

   c. gloves

   d. spats (foot protection)

C. Material Handling

1. Heavy materials

2. Sharp materials

3. Hot materials

4. Material handling equipment

5. Hazardous material

   a. gases

   b. flammables

   c. solvents

D. Shop Maintenance

1. Equipment and tools

2. Clean-up

3. Chips

4. Oil spills, water

III. Review Materials

A. Types of materials

B. Characteristics of metals

C. Uses of metals

D. Identification of metals

E. Cost, comparison, estimating

F. Reclaiming and salvage

IV. Measurement

A. Use of measurement, English/metric

B. Review measurement instruments and tools

1. Steel rule, tape rule

2. Calipers

3. Micrometers

4. Protractors

5. Depth measurement instruments

6. Combination set

7. Gauges

V. Drawing and planning

A. Freehand sketching, using symbols and lines

B. Blueprint reading

C. Related information on drawings

D. Student planning sheet

1. Drawing

2. Materials list

3. Materials cost

4. Procedural steps

VI. Cutting Machines

A. Introduction to cutting machines

1. Characteristics of cutting machines

2. Characteristics of cutters

3. Cutting speeds and feeds

4. Cutting fluids and coolants

5. Cutting machine safety

B. Drill Press

1. Review operation of drill press and controls

2. Set-up

3. Holding devices

4. Other operations

C. Lathe

1. Review operation of lathe and controls
2. Lathe set-up
3. Work holding methods
4. Cutting tool design and use
5. Lathe operations

D. Milling Machine

1. Introduction to milling machines
2. Introduction set-up
3. Introduction to cutters
4. Operation of the milling machine(s)

E. Surface Grinder

1. Introduction to surface grinders
2. Introduction to set-up and work holding
3. Grinding wheels and dressing
4. Operation of the surface grinder

VII. Shaping and Forming

A. Review machines and power tools

B. Perform advanced techniques

1. Rotary machine

2. Bending machines

C. Forging

1. Basic Procedures

2. Tools and equipment

VIII. Joining and Fastening

A. Review soldering/brazing

B. Welding

1. Introduction Gas Welding

2. Introduction Arc Welding

3. Introduction TIG

4. Introduction MIG

IX. Foundry Procedure

A. Review safety

B. Review tools and equipment

C. Review foundry procedures

D. Advanced techniques and procedures

X. Heat Treatment

Review heat treatment and procedures

XI. Metal Finishing

Review finishing processes and techniques

1. Hand processes

2. Machine processes

XII. Career and Vocational Guidance

A. Review Metal Working Occupations

B. Occupational Requirements

C. Vocational Guidance

XIII. Consumer Awareness

A. Review product selection, function and design

B. Economic factors

C. Product integrity

CURRICULUM ADVANCED METALWORKING

I. Introduction to area

A. Review shop procedure and regulations behavior

B. Review shop safety

1. Fire exits and procedures

2. Emergency switches and shut-offs

C. Review shop organization and procedure

D. Review maintenance of tools and equipment

E. Introduce course syllabus and expectations, requirements

II. Review shop safety

A. Eye protection

1. Glasses

2. Face shields

3. Welding helmets

4. Welding goggles

B. Personal protection

1. Clothing - loose clothing

2. Jewelry - rings, watches, chains

3. Hair

4. Proper protective clothing

   a. aprons

   b. coats

   c. gloves

   d. spats (foot protection)

C. Material Handling

1. Heavy materials

2. Sharp materials

3. Hot materials

4. Material handling equipment

5. Hazardous material

   a. gases

   b. flammables

   c. solvents

D. Shop Maintenance

1. Equipment and tools

2. Cleanup

3. Chips

4. Oil spills, water

5. Machine repair

III. Review materials

IV. Measurement

A. Review measurement instruments and tools

1. Micrometers

2. Depth measurement instruments

3. Gauges

4. Dial indicators

B. Introduce metrics and metric measuring tools

V. Drawing and planning

A. Review blueprint reading

1. Machining specifications

2. Specialized areas

3. Abbreviations, standards, and symbols

4. Reading numerical control documents

B. Review related information on drawings

C. Review student planning sheet

1. Drawing

2. Materials list

3. Materials cost

4. Procedural steps

VI. Cutting Machines

A. Review of cutting machines

1. Characteristics of cutting machines
2. Characteristics of cutters
3. Cutting speeds and feeds
4. Cutting fluids and coolants
5. Cutting machine safety
6. Advanced cutting techniques
7. Jigs and fixtures

B. Drill Press

1. Review operation of drill press and controls
2. Review set-up
3. Review holding devices
4. Specific operations
5. Drill nomenclature and sharpening
6. Machine maintenance

C. Lathe

1. Review operation of lathe and controls
2. Review lathe set-up

3. Review work holding methods

4. Review cutting tool design and use

5. Specific lathe operations

6. Grinding cutting tools

7. Machine maintenance

D. Milling Machine

1. Review milling machines

2. Review set-up

3. Review cutters

4. Specific operations of the milling machine(s)

5. Machine maintenance

E. Surface Grinder

1. Review surface grinders

2. Review to set-up and work holding

3. Review grinding wheels and dressing

4. Specific operation of the surface grinder

5. Machine maintenance

VII. Shaping and Forming

A. Extrusion

B. Punching

1. Procedure

2. Dies and equipment

3. Tool and die

C. Forming

1. Basic procedures

2. Tools and equipment

3. Jigs and fixtures

VIII. Joining and Fastening

A. Welding

1. Review gas welding

2. Review arc welding

a. TIG

b. MIG

3. Thermite welding

4. Induction welding

5. Resistance welding

6. Flow welding

7. Forge welding

IX. Foundry Procedure

A. Review safety

B. Review tools and equipment

C. Review foundry procedures

D. Advanced techniques and procedures

E. Pattern making and design

X. Heat Treatment

Review heat treatment and procedures

XI. Inspection and testing

A. Introduce methods of inspection

B. Introduce methods of testing

1. Destructive

2. Non-destructive

XII. Metal Finishing

A. Electroplating

B. Chemical treatment

C. Heat finishing

XIII. Nontraditional Machining Processes

A. Flame spraying

B. Electrical discharge machining

C. Chemical milling

D. Laser beam

E. Electron beam

F. Electro chemical machining

G. Ultrasonics

H. Explosive forming

I. Powder metallurgy

XIV. Career and Vocational Guidance

A. Review metal working occupations

B. Occupational requirements

C. Vocational guidance

D. Apprentice programs

E. Post graduate education

XV. Consumer Awareness

A. Review product selection, function and design

B. Economic factors

C. Product integrity

METALWORKING SAFETY GUIDE

Working safely is the first essential students should learn even before they are taught how to operate any of the machine tools or use hand tools in your shop. The student can easily learn to work safely, and it is just as easy to learn the safe way of doing things as it is to learn the unsafe way.

Safety is an attitude; that is, it is a frame of mind. If the students' attitude towards safety is a good one, they will accept the idea that safe working habits are the ones to learn and practice for the rest of their lives. Most important, the student must make up his mind that working with other people in the shop is his business. Keeping themselves, as well as those working with them, free from accidents is also part of their attitude towards safety.

I. Hand Tool General Safety Requirements

A. Secure Approval: Secure your instructor's approval for all work you plan to do in the shop.

B. Clothing: Dress properly for your work. Remove

coats and jackets, tuck in your shirt, roll up loose sleeves, and remove jewelry. It is advisable to wear protective clothing.

C. Eye Protection: Wear appropriate eye and/or face protection at all times while doing any operations that may endanger your eyes. It is a law, in the State of Connecticut, that you wear eye protection at all times in the shop. Be sure you have enough good light to see what you are doing without straining your eyes.

D. Clean Hands: Keep your hands free of oil or grease.

E. Consideration of Others: Be thoughtful and helpful towards other students in the class. Be sure the work you are doing does not endanger someone else. Caution other students if they are violating a safety rule.

F. Tool Selection: Select the proper size and type of tool for your work. You should never use a tool if it is not sharp and in good condition. Inform your instructor if tools are broken, have loose handles, or need adjustment.

G. Carrying Tools: Keep edged and pointed tools turned down and do not swing your arms or raise them over your head while carrying them. Carry only a few tools at one time unless they are in a special holder. Do not carry any sharp tools in your pocket.

H. Clamping Stock: Whenever possible, mount the work in a vise, clamp, or special holder. This is especially important when using chisels, hack-saws, or portable electric tools.

I. Using Tools: Hold a tool in the correct position while using it. Most edged tools should be held in both hands with the cutting motion away from you. Be careful when using your hands or fingers as a guide to start a cut.

J. Working Speed: Pace your work to complete a given task in the class time. Do not rush or tear through your work.

K. Bench Organization: Keep your project materials carefully organized on your bench, with the tools located near the center. Do not pile tools on top

of each other. Never allow sharp tools to extend out over the edge of the bench. Protection must be provided for materials that extend over the edge of the bench. Close your vise when it is not in use and see that the handle is turned down. Keep drawers and cabinet doors closed.

L. Floor Safety: The floor should be kept clear of scrap metal and shavings and excessive litter. Keep projects, metal, and other equipment and materials you are using out of traffic lanes. Wipe up immediately any liquids spilled on the floor.

M. Material and Project Storage: Store and stack your project work carefully in assigned areas. If the storage is overhead, be sure the materials will not fall off. Straighten the metal rack when you remove a piece of metal. Do not leave sheet metal protruding from the end of the storage rack.

N. Lifting: Protect your back muscles when lifting heavy objects. Have someone help you, and lift with your arm and leg muscles. Secure help with long pieces of metal even though they may not be heavy.

O. For Protection and Prevention: Become familiar with fire evacuation procedures and the use of fire equipment. Apply, handle, and store flammable materials only in approved areas. Close cans of finishing materials and thinners immediately. Use flammable liquids in very small quantities. Be sure containers are labeled. Dispose of oily rags and other combustible materials immediately in an approved container. Secure the instructor's approval before you bring any flammable liquids into the shop.

P. Air Tools: Use air tools and equipment with extreme caution.

Q. Injuries: Students must report all injuries, even though slight, to your instructor.

II. Hand Tool Safety Rules

A. Screwdrivers

1. Select screwdrivers to fit the screw head being used.

2. Keep screwdriver handles in safe condition.

3. Do not use a hammer on a screwdriver handle.

4. Avoid holding work in the hand when using a screwdriver on it, as it may slip and cause stab wounds.

B. Wrenches

1. Discard wrenches that are spread, or badly worn.

2. Select open-end wrenches to fit the job.

3. Where possible, avoid using an adjustable or monkey wrench.

4. If a wrench has become burred, grind off the rough spots to avoid cutting the hands.

5. It is generally safer to pull a wrench towards you than to push it away from you.

6. Be sure that your knuckles will clear obstructions when the wrench turns.

C. Hammers

1. Hammers that are chipped should be discarded.

2. Never use a hammer that has a loose or split handle.

3. Never hit the head of one hammer with the

face of another, they could chip and cause injury.

D. Chisels

1. In using a chisel and hammer, keep the chisel head free from burring by grinding it if necessary.
2. Where chips may fly, use a chip screen.
3. Hold the chisel and hammer firmly and keep the chisel head and the face of the hammer clean and free from grease.

E. Files

1. Always use a file with a handle.
2. When filing on the lathe, learn to file with the left hand.
3. Keep the file and your hands clear of the chuck jaws or dog.
4. Do not use a file as a pry bar.
5. If filing on a lathe, do not use a pad of cloth or waste under the thumb on the end of the file.
6. Keep a firm grip on the file at all times.

7. Do not blow filings so that they can go into anyone's eyes.

F. Hacksaw

1. Use the correct blade for the job.
2. See that the blade is correctly secured in the frame.
3. When the saw breaks through the work, ease up on the pressure, so that the hand will not strike the work or vise.
4. Be sure that the work is held securely in the vise.
5. Do not force the cut.

G. Taps and Dies

1. Be sure the work is firmly mounted in the vise.
2. Secure the proper size of tap wrench.
3. If a broken tap is removed by using a punch and hammer, wear additional face protection.
4. If a long thread is cut with a hand die, keep your hands and arms clear of the sharp threads coming through the die.

III. Metal Machinery General Safety Requirements

A. Always be sure you have the instructor's approval to operate a machine.

B. Wear appropriate clothing. Remove coats or jackets, loose jewelry, tuck in loose clothing and roll up loose sleeves above the elbows. Always wear appropriate eye protection.

C. You must be wide awake and alert. Never operate a machine when you are tired or ill.

D. Think through the operation before performing it. Know what you are doing and what the machine will do.

E. Make all the necessary adjustments before turning on the machine. Some adjustments on certain machines will require the instructor's approval.

F. Never remove or adjust a safety guard without the instructor's permission.

G. Keep the machine and working surfaces clear of tools, stock, and project materials. Also keep the floor free of scraps and excessive litter.

H. Allow the machine to reach its full operating speed before starting to feed the work. Always set the machine for the correct cutting speeds.

I. Feed the work carefully and only as fast as the machine will cut it easily.

J. Maintain the MARGIN OF SAFETY specified for the machine. This is the minimum distance your hands should ever come to the cutting tool while it is in operation.

K. If a machine cutter is dull, the machine out of adjustment, or in some way not working properly, shut off the power immediately, and inform your instructor.

L. You are the one to control the operation. Start and stop the machine yourself. If someone is helping you, be sure they understand this and know what they are expected to do and how to do it.

M. Do not allow your attention to be distracted while operating a machine. Also, be certain that you do not distract the attention of other machine operators.

N. Stay clear of a machine that is being operated by another student. See that other students are not in your way while you are operating a machine.

O. When you have completed an operation on a machine, shut off the power and wait until it stops before leaving the machine or setting up another cut. Never leave a machine running unattended.

P. Do not play or tamper with machines in the shop. Each tool or machine was designed for a specific operation, and should not be used as a toy.

Q. Do not crowd around or wait in line to use a machine. Ask the present operator to inform you at your work station when he or she has finished. Common standards of courtesy may slow you down a little, but they will make the shop a more pleasant and safer place to work.

IV. Machine Safety Rules

A. Abrasive Belt Sander

1. Adjust table to desired angle.

2. Check belt for proper tension.

3. Hold material properly.

4. Apply light pressure when sanding.

5. Take care not to bring fingers in contact with abrasive belt.

6. Do not clean machine when running.

B. Power Saws

1. When turning on power, stand to one side of the saw. Adjust speed to suit work.

2. When saw is operating, do not bend over it.

3. Mount work only when saw is stopped.

4. Support protruding end of long work so material being cut off will not fall and possibly injure anyone. Be sure that the protruding end is well guarded against anyone coming in contact with it.

5. When using the sliding stock guide, do not allow fingers to project beyond the end so that they could come in contact with the saw teeth.

6. Be sure that the blades are in good condition before using.

7. If the blade does break in work, shut off the power and do not attempt to disengage blade from work until the machine has come to a complete stop.

C. Buffer and Wire Wheel

1. Have safety shields over wheels.
2. Hold work below the center of the wheel.
3. Wear proper safety protection.
4. Keep a good hold on material being polished so it will not catch and pull your hands into the wheel.

D. Drill Press

1. Use drills properly sharpened to cut to the right size and check that the drill is running true.
2. Drills should be running at the proper speed, according to its size, and the kind of material to be drilled.
3. Chuck wrenches must be removed from drill chuck at all times.
4. Never attempt to hold work under the drill by hand. Always clamp work to the table.

5. Feed drill only at proper speed; forcing or feeding too fast may result in a broken or splintered drill and serious injuries.

6. When changing the belt for speed regulation, make sure that the power is OFF and the machine has come to a dead stop.

7. If the work should slip from the clamp, never attempt to stop it with the hands. Stop the machine and then make the necessary adjustments.

8. If drill stops or binds in work, shut off the motor and reverse the drill by hand.

9. File or scrape all burrs from drilled holes.

10. Do not reach around or in back of a revolving drill.

11. Keep your head back and well away from any moving part of the drill press.

E. Engine Lathe

1. Before turning on the power, check to see that the tailstock, tool holder, and job are properly clamped and proper clearance is maintained.

2. Use hand power only when putting on or removing chuck or faceplate. Do not use the power that operates the lathe.

3. When assembling or removing the chuck, place a board on ways to prevent damage to machine and possibly to operator in case the chuck falls. Have firm grip on chuck as it nears the end of threads.

4. Do not leave chuck wrench or any other tool in the chuck. If machine is turned on, wrench may fly out and injure the operator or any other person.

5. Do not use wrench on revolving work or parts.

6. Never try to measure work or feel the edge, or adjust a cutting tool when lathe is running.

7. Do not take heavy cuts on long slender work. Doing so may cause the job to fly out of the machine.

8. When filing, be sure that the tang of the file is fitted with a proper handle. Stand

to one side so that, if the file is forced upward, it will go past the body rather than against it.

9. Do not shift or change gears while the lathe is running.

10. Stand erect with your weight equally distributed on both feet.

F. Grinder (Pedestal Type)

1. Stand to one side out of line of wheel when starting it up.

2. The face of the wheel must be flat, free from grooves, and free from foreign material.

3. Work should be fed slowly and gradually. Using too much pressure, or striking wheel suddenly, may cause it to break.

4. Make sure that the tool rest is not over 1/8 inch from the face of the wheel. Frequently check this distance, and adjust as necessary. Do not set tool rest while machine is in motion.

5. Use face of wheel only, unless it is designed for grinding on the side; otherwise, side

pressure may break the wheel. Whenever possible, use the entire face of the wheel to avoid grooving.

6. Make sure all guards are installed and properly adjusted.

7. Never use a grinding wheel that is loose on the shaft or if its rate of speed is not safe for the number of r.p.m. of the spindle. Check with your instructor for this information.

8. Stop wheel if it chatters or vibrates excessively. This may be a danger signal that the wheel is not properly balanced or not attached securely to the spindle.

9. All wheels should be tested for soundness. The instructor will usually do this.

10. Hold job against wheel firmly so that it will not slip out of the hand and cause hands and fingers to come in contact with the wheel.

11. Use clamp or other suitable holding devices for grinding short pieces.

12. Always use face shield or goggles as well as protective glass shields.

G. Grinder (Surface Type)

1. Be sure magnetic chuck is thoroughly clean.
2. Test holding power of chuck before starting the machine.
3. Stand to one side of wheel before starting it up.
4. Check to see that wheel properly clears work.

H. Milling Machine

1. Make sure that the cutter and arbor are secure and that the cutter and arbor support clear the work.
2. Use only cutters that are correctly ground and in good condition.
3. To avoid striking hands on the cutter while setting up, move table with work as far away from cutter as possible.
4. When using cutters in a milling machine, do not take an excessively heavy cut or feed. Such a feed or cut could break the cutter and injure the operator.
5. Do not try either to tighten or take off arbor nut by applying power to machine. Make

sure motor is OFF.

6. Check speeds and feeds, and feed work against direction in which cutter is rotating.

7. Keep hands away from work when machining.

8. Never reach over a revolving cutter, especially the side of cutter which cuts into the work.

9. Use a brush not the hands to remove chips, and always turn off cutter before trying to remove chips.

I. Shaper (Advise to eliminate from the school shop)

1. Be sure ram, tool head, tool, work, table-support clamping screws, and vise are properly secured in place, or position, and that the tool head and tool clear the work before starting the shaper. Place a metal shield or heavy close-mesh wire screen over the tool to catch the chips.

2. After setting the stroke length and position, check to see that adjusting nuts are tight.

3. Remove all wrenches from machine after completing set-up.

4. Stand parallel to direction of stroke of machine when it is running and never reach across the table between strokes of the ram.

5. Never remove chips while ram is in motion.

J. Spinning Lathe

1. Beware of sharp-pointed metal edges when cutting the metal disc to size and when getting it ready for spinning.

2. Check over the spinning lathe to be certain that it is in a safe condition for spinning.

3. Be sure the tool post is securely tightened in place before attempting to spin.

4. Always wear goggles.

5. Remove all burrs from metal that were formed during the trimming operation with a file.

6. Make certain the spinning tools are fitted solidly to the handle.

7. Never stand in line with the disc during the operation.

8. Always double check the condition of the follow block on the disc. Remember to re-tighten the tailstock after the disc has been centered.

9. Use care when handling a disc that has been annealed and may still burn you if you do not use tongs or wear gloves.

10. Do not attempt to do spinning unless you are positive of what must be done and how it is to be done. Seek help if you are in doubt or do not know a specific operation.

V. Portable Power Equipment

A. General Requirements

1. Do not attempt to oil, clean, adjust or repair any portable power tool while it is running.

2. Always wear proper clothing and eye protection.

3. Do not operate any portable tool unless authorized to do so by the instructor, or under supervision.

4. Do not try to stop any portable tools with your hands or body.

5. Always see that the work and cutting tools on any portable tools are clamped securely before starting.

6. Keep the floor clear of metal chips or curls and waste pieces.

7. Concentrate on the work and do not become distracted while operating portable equipment.

B. Portable Electric Tools, Safety Rules

1. Select suitable location when using a portable electric tool or appliance, so as to avoid electric shock.

2. Remove electrical plug before using the chuck key or other adjusting devices.

3. Be sure the switch is in the OFF position before plugging into the socket.

4. Support the work securely before using portable electric tools.

5. When finished with a portable electric tool, turn off the switch and hold equipment firmly until it comes to a complete stop.

6. Inspect power tools for worn or damaged parts.

VI. Hot Metals Safety Requirements

A. Casting

1. Never pour a casting unless you are wearing protective clothing and goggles.

2. Moisture and molten metal react violently. Under no condition should moist or wet metal be added to molten metal.

3. Place hot castings where they will not cause accidental burns or fire.

4. Keep foundry area clean.

5. Be sure your safety clothing is in first-class condition.

6. Do not distract anyone while they are pouring a casting.

7. Stand to one side of the mold as you pour, never directly in front of it. Steam is often generated during the pouring operation and may scald you.

8. Clamp or weight down molds of large castings to prevent the mold from floating and permitting molten metal to escape from the mold at the parting line.

9. Place the mold on a surface covered with dry sand, before you pour the molten metal.

B. Forging Metals

1. Never work in the forging area unless you are wearing protective clothing and goggles.

2. Make sure area is clean and free from obstructions.

3. Always turn off the blast before lighting a forge fire. If the blast is turned on while one is working over the forge hearth, there is serious danger of getting dirt and dust in the eyes and throat.

4. Always turn on the exhaust system before starting to light any furnace, thus preventing an accumulation of dust and smoke in the classroom.

5. Use the bolt tongs when handling round or octagon shapes. When such work is held with the flat tongs, there is danger of its flying loose when struck with a hammer. Cool the tongs frequently.

6. Avoid striking the anvil with the hammer as this creates a lot of unnecessary noise. Also there is the danger of pieces flying off the hammer or anvil.

7. Do not leave heated metal lying around where other people may accidentally come into contact with it.

8. Always acquaint an assistant with any hazardous conditions, such as grasping a piece of hot metal with the bare hands.

9. When hammering on the anvil, stand in the proper position.

VII. Welding - Brazing - Soldering Safety Requirements

A. Soldering & Brazing

1. Use care when storing the soldering copper after use. Improper storage can result in serious burns or fire.

2. Wash your hands thoroughly after using soft solder and fluxes.

3. Protect your eyes from splattering solder

and do not get flux in your eyes.

4. Have cuts and burns treated properly and promptly.

5. Tin the soldering copper in a well-ventilated area.

6. Do not touch joints that have just been soldered.

7. Because of the temperatures reached and the composition of silver brazing alloys, good ventilation is a must. The fumes are poisonous and should be removed at the point of origin.

8. Use care when handling objects that have just been brazed.

9. Wear goggles when cleaning surfaces with an acid solution or with a wire brush.

10. Double check to be certain that all gas valves have been turned OFF after completing the job.

B. Gas Welding

1. Check equipment for condition and proper location.

2. Wear approved goggles when welding. The lenses are made in different degrees of

density, select the proper lens for the job.

3. Never light the torch with matches. Use a spark-lighter.

4. Do not allow anyone to watch you weld unless they wear suitable goggles.

5. It is only necessary to turn off the torch if you are going to reposition the work; however, the entire unit should be turned off if the welding job is completed. Carefully hang up the torch.

6. Never light the torch with both valves open.

7. For added protection, wear welding gloves, leather apron, and sleeves when welding.

8. Never attempt to blow dirt off your clothing with gas pressure. The clothing will become saturated with oxygen and/or acetylene and will literally explode if a spark comes in contact with it.

C. Electric Welding

1. Never electric weld or watch electric welding being done without using a protective shield

made specifically for Arc welding.

2. Wear goggles when chipping slag.

3. Wear approved clothing for welding.

4. Do not weld where solvent or paint fumes may collect. Remove all flammable materials from the welding area.

5. Weld only in a well-ventilated area.

6. Report any cuts or burns promptly to instructor.

7. Wear goggles under the shield for additional protection.

8. Do not weld containers until you can determine whether they stored flammable liquids. If they have, get them steam cleaned or fill them with water before welding. Vent all containers that are to be welded.

9. The power should be OFF before set-up and returning the torch handle or electrode holder.

10. Remove electrode from holder when not in use.

D. Spot Welding

1. Wear goggles and gloves.

2. Select proper setting for material being used.

3. Weld only in well ventilated area.

4. Treat any cuts or burns promptly.

VIII. Finishing Operations Safety Requirements

A. Read instructions on finish container and follow them carefully.

B. Wash your hands after applying finish or using solvents to clean the work.

C. Examine the work for rough edges and burrs before attempting to clean it.

D. Use a well-ventilated area to apply finishes.

E. Keep open flames and sparks away from areas where finishes are being applied or solvents being used.

F. Use a filter mask when spraying finishes.

G. Wear goggles when buffing.

H. Secure immediate medical attention if solvents or foreign matter get into your eye.

I. Clean up any spilled solvents or finishes.

J. Dispose of used waste or wiping cloths by placing them in steel, approved safety cans.

IX. Preventive Maintenance

A. Put tools not in use in a safe place while you are working.

B. Put tools away when you are through with them.

C. Have an assigned place for each tool.

D. Do not leave sharp tools protruding from bench.

E. Always use the right tool for the job.

F. Handle precision measuring tools with great care.

G. Wipe precision tools clean of finger prints after using and keep in separate boxes or cases.

H. Apply a light dressing of oil on precision tools when in storage.

I. Keep tools sharp.

J. Use proper speeds for cutting tools.

K. Keep machines properly oiled and cleaned at all times.

L. Properly apply the tool in the machine and use a proper coolant and lubricant.

M. Keep all hand tools and machines in proper working condition.

SUGGESTED TEXT & REFERENCE BOOKS

The following is a list of suggested text and reference books that has been compiled by this committee. We feel that this list is representative of the books available in each of the subject areas, however you may find others that fit your program and methods of teaching. We have listed the books by their major area of emphasis.

Art Metalworking - - - - - - -

Sheet Metalworking - - - - - -

Metals Machining - - - - - - -

Foundry - - - - - - - - - - - -

Forging - - - - - - - - - - - -

Welding - - - - - - - - - - - -

Projects - - - - - - - - - - - -

Miscellaneous - - - - - - - - -

Professional - - - - - - - - - -

Art Metalwork

	Title	Author	Publisher
1.	Art Metals	Siegner	Goodhart & Wilcox
2.	Art Metals & Enameling	Hawkins	Bennett
3.	Creative Metal Sculpture	Morris	Bruce
4.	Direct Metal Sculpture	Mielach & Seiden	Crown
5.	Wire Sculpture & Other Three Dimensional Construction	Bromer	Davis
6.	Creative Metal Design	Ullrich & Klante	Reinhold

Sheet Metalworking

Title	Author	Publisher
1. Sheet Metal Work: A. Hand Processes B. Machine Processes C. Measurement & Layout D. Sheet Metal Job Sheets ?		Delmar
2. Sheet Metal Shop Practices	Meyer	American Tech. Society
3. Sheet Metal Pattern Drafting & Shop Problems	Dougherty	Bennett
4. Sheet Metal Technology	Budzik	Sams
5. Safety for Sheet Metal Workers	Zinngrabe	Delmar
6. Sheet Metalwork	Smith	McKnight

Metals Machining

	Title	Author	Publisher
1.	Machinery Handbook	Oberg & Jones	Industrial Press
2.	Machine Tool Technology	McCarthy & Repp	McKnight
3.	Machining Fundamentals	Walker	Goodheart-Willcox
4.	Machine Tool Metalworking	Feirer	McGraw-Hill
5.	Machine Tool Operations	Burghardt	McGraw-Hill
6.	Machine Shop Operations & Setups	Iascoe	American Tech. Society
7.	General Industrial Machine Shop	Johnson	Bennett
8.	How to Run a Lathe	South Bend Lathe	South Bend Lathe
9.	Machine Shop Series A. Bench Work B. Drill Press Work C. Heat Treatment of Metals	?	Delmar
10.	Modern Metalworking	Walker	Goodheart-Willcox
11.	The Starrett Book for Student Machinists	?	L. S. Starrett Co.
12.	Technical Metals	Johnson	Bennett
13.	General Metals	Feirer	McGraw-Hill

	Title	Author	Publisher
14.	Machine Tools & Machining Practices	White, Neely Kibbe, Meyer	Wiley
15.	Metalwork Technology & Practice	McGrath & Ludwig	McKnight
16.	Metal Manufacturing Technology	Chaplin	McKnight
17.	Fundamentals of Machine Technology	Olivo	Breton

Foundry

	Title	Author	Publisher
1.	Patternmaking & Founding	Smith	McKnight
2.	An Elementary Foundry Manual	Walter	McEnglevan Heat Treating & Mfg. Co.
3.	Lost Wax Investment Casting	Ammen	Tab Books
4.	The Fundamentals of Iron and Steel Casting	Gagnebin	International Nickel Co.
5.	Foundry Practices	Rusinoff	American Tech. Society

Forging

	Title	Author	Publisher
1.	The Making of Tools	Weygers	Van Nostrand
2.	The Modern Blacksmith	Weygers	Van Nostrand
3.	Forging & Welding	Smith	McKnight
4.	The Art of Blacksmithing	Bealer	Funk & Wagnalls
5.	Early American Ironware Cast & Wrought	Dauffman	Weathervane
6.	The Blacksmith's Craft Wrought Iron Work Decorative Iron Work	Council for Small Industries in Rural Areas London, England	
7.	Decorative & Sculptural Iron Work	Meilach	Crown

Welding

	Title	Author	Publisher
1.	Modern Welding Tech.	H.B. Cary	Prentice-Hall
2.	Arc Welding-Basic Fund.	Walker	Goodheart-Wilcox
3.	Welding Technology	Kennedy	Bobbs/Merrill
4.	Welding Principles & Practices	R.J. Sacks	Bennett
5.	Modern Welding	Althouse, Turnquist Bowditch	Goodheart-Wilcox
6.	Arc Welding	Walker	Goodheart-Wilcox
7.	Oxyacetylene Welding	R.J. Baird	Goodheart-Wilcox
8.	Gas & AC Arc Welding & Cutting	?	McKnight
9.	Principles of Industrial Welding		Lincoln Arc Welding
10.	Arc Welding Lessons for School & Farm Shops	?	Lincoln Arc Welding
11.	Metals & How to Weld Them	Jefferson & Woods	Lincoln Arc Welding
12.	Practical Welding	Scheck & Edmonson	Glencor Pub. Co.
13.	Welding Instruction for the Beginner	Sosnin	Lincoln Arc Welding

	Title	Author	Publisher
14.	Welding Projects for School Shops	?	Hobart School of Welding
15.	Welding & Welding Tech.	Little	McGraw-Hill
16.	Welding Skills & Practices	Giachino & Weeks	American Tech. Society
17.	Welding Fundamentals	Madsen	American Tech. Society

Projects

	Title	Author	Publisher
1.	Early American Metal Projects	Daniele	McKnight
2.	Metal Projects Book	Walker	Goodheart-Wilcox
3.	Projects in General Metalwork	Ruley	McKnight
4.	Practical Metal Projects	Ruley	McKnight
5.	Shop Drawings of Shaker Iron & Tinware	Handberg	Berkshire Traveller Press
6.	Metal Projects Book	Feirer	Goodheart-Wilcox
7.	Contemporary Metal Home Furnishings	Lux & Towers	McKnight
8.	Machine Shop Projects for Trade, Vocational, & High School Shops	R.E. McKnight	McKnight

Miscellaneous

	Title	Author	Publisher
1.	Supervisors Safety Manual	?	National Safety Council
2.	Accident Prevention Manual	Strong	National Assoc. of Industrial & Tech. Teacher Educators
3.	Accident Prevention Manual for Industrial Operators	?	National Safety Council
4.	Properties & Uses of Ferrous & Nonferrous Metals	Kazanas	Prakken
5.	Metallurgy Theory & Practice	Allen	American Tech. Society
6.	Designing Todays Manufactured Products	Lindbeck	McKnight
7.	Manufacturing Processes, Materials & Production	Rusinoff	American Tech. Society
8.	General Industry	Lindbeck	Bennett
9.	Understanding American Industries	Gerbracht	McKnight
10.	Elements of American Industry	Smith	McKnight
11.	Manufacturing Processes	Bogeman	Wiley
12.	Mathematics of the Shop	McMackin	Delmar

	Title	Author	Publisher
13.	Hardening & Tempering Engineers Tools	Gentry	Model & Allied
14.	Blueprint Reading for Industry	W.C. Brown	Goodheart-Wilcox
15.	Mathematics for Machine Technology	Smith	Delmar
16.	Mathematics for Industrial Careers	Singer	McGraw-Hill
17.	Practical Problems in Mathematics for Machinists	Bradley	Delmar
18.	Basic Problems in Mathematics for Welders	Schell & Matlock	Delmar
19.	Metallurgy	Johnson & Weeks	American Tech. Society
20.	Tool Design	Cole	American Tech. Society
21.	Machine Design	Winston	American Tech. Society
22.	Jig & Fixture Design	?	Delmar

Professional

	Title	Author	Publisher
1.	Instructors & Their Jobs	Miller & Ross	American Tech. Society
2.	Course Construction in Industrial Arts & Vocational Tech. Education	Giachino & Gallington	American Tech. Society
3.	Instructional Analysis & Materials Development	Bartel	American Tech. Society
4.	School Shop	?	Prakken Pub.
5.	Industrial Education	?	Harcourt-Brace